Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Continuous Diffusion Flames and Flame Streets in Micro-Channels SHIKHAR MOHAN, MOSHE MATALON, University of Illinois at Urbana Champaign — Experiments of non-premixed combustion in micro-channels have shown different modes of burning. Normally, a flame is established along, or near the axis of a channel that spreads the entire mixing layer and separates a region of fuel but no oxidizer from a region with only oxidizer. Often, however, a periodic sequence of extinction and reignition events, termed collectively as "flame streets", are observed. They constitute a series of diffusion flames, each with a tribrachial leading edge stabilized along the channel. This work focuses on understanding the underlying mechanism responsible for these distinct observations. Numerical simulations were conducted in the thermo-diffusive limit in order to study the effects of confinement and heat loss on non-premixed flames in three-dimensional micro-channels with low aspect ratios. The three dimensionality of the channel was captured qualitatively through a systematic asymptotic analysis that led to a two dimensional problem with an effective parameter representing heat losses in the vertical direction. There exist three key flame regimes: (1) a stable continuous diffusion flame, (2) an unsteady flame, and (3) a stable "flame street"; the transition between regimes demarcated primarily by Reynolds and Nusselt numbers.

Moshe Matalon
University of Illinois at Urbana Champaign

Date submitted: 23 Jul 2015 Electronic form version 1.4